GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-241189

December 18, 1990

The Honorable Robert C. Byrd
Chairman, Committee on Appropriations
United States Senate

The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate

As you requested, we have reviewed the sensitivity of estimated procurement costs of selected military aircraft programs to reductions in numbers of aircraft purchased per year.[1]

Background

The growing need to decrease the federal budget deficit and a diminishing threat from the Soviet Union and the virtual collapse of the Warsaw Pact as a military alliance make the defense budget a prime candidate for budget cuts. The Department of Defense's (DOD) efforts to identify where these cuts can be made have caused it to examine weapon systems' quantity requirements and procurement rates. For example, a recent major aircraft review by the Secretary of Defense proposed significant reductions in the procurement of the C-17, B-2, and A-12 aircraft.

The Congress has been concerned that DOD has historically planned for higher production rates of its weapon systems and lower unit costs than are actually realized. When funding limitations reduce the planned annual procurement rate, unit costs generally increase. The Congress has called for an end to this optimistic planning and is evaluating the appropriate level of procurement for several weapon systems.

Results in Brief

Aircraft procurement unit costs generally increase as their procurement rates decrease. However, some mature Air Force and Navy procurement programs, including those for the KC-135R engine modification, F/A-18, F-16, AV-8B, and F-15, would not show as significant a unit cost increase as other aircraft programs if their procurement rates were decreased. For example, using Navy assumptions, a 25 percent decrease in the

[1]The number of aircraft systems the Air Force and Navy are authorized to buy per year is sometimes referred to as the procurement rate.

F/A-18 procurement rate would increase unit cost by about 8 percent; for the E-2C, however, a 25 percent procurement rate decrease would increase unit cost by 25 percent.[2]

According to contractors, the procurement unit cost of some mature aircraft systems is less sensitive to procurement rate reductions when at least one of the following factors is present: (1) contractors have an opportunity to manage overhead and other costs in anticipation of production rate changes, (2) foreign customers' requirements can offset reductions in the U.S. procurement quantities, and/or (3) multiyear procurement can be used to stabilize prices over a longer production period.

Also according to contractors, unit cost is especially sensitive to sudden unanticipated changes in production rates. Unit costs are less sensitive when rate reductions are planned and fixed costs such as overhead and facilities can be reduced.

These circumstances demonstrate the importance of program stability. When procurement rate decreases need to be made, contractors should be given sufficient advance notice so they can eliminate unnecessary facility, overhead, and other costs before the production rate decreases begin.

Unit Cost Sensitivity Varies Among Aircraft Programs

Our review of seven mature aircraft programs using military service projections indicated that the procurement unit cost of some aircraft may be less sensitive to rate changes than others.[3] When the number of E-2C and EA-6B aircraft to be purchased per year is decreased by 25 percent, their projected unit costs increase 25 and 21 percent, respectively. A 50 percent decrease in the E-2C's and EA-6B's procurement rates would increase unit cost by 53 and 64 percent, respectively. On the other hand, unit costs estimates for aircraft programs such as the KC-135R modifications, F/A-18, F-16, AV-8B, and F-15 are not as sensitive to decreased procurement rates. Because each of these systems is affected by different conditions, we evaluated unit cost sensitivity to production rate changes on a case-by-case basis.

[2]The E-2C is also a mature system, but because of its relatively low production rate (six in 1989 and four in 1990), its unit cost is especially sensitive to production rate decreases.

[3]The projections noted in this report are based on the military services' assumptions of charges in overhead and other fixed costs.

The data in the following tables show the effect of only short-term and unanticipated production rate changes. Unit cost increases can be substantially moderated by the extent contractors can plan for production rate changes and are willing to make reductions in overhead and other fixed costs.

Initiatives such as multiyear procurements can assist the contractors in planning for such reductions. For example, when the AV-8B was reduced from a 56-per-year annual procurement to a 23-per-year multiyear procurement, the unit cost increased 12 percent. Representatives of one major aircraft manufacturer stated that the earlier they know of a rate change the less sensitive the unit costs will be to the changes.

In some cases production rate changes in one program can impact the unit cost of other programs. For example, the F-15 contractor's facility currently houses two other aircraft production programs (the F/A-18 and the AV-8B).

KC-135R Aircraft

The KC-135R's unit cost is relatively insensitive to the rate at which the engines are procured and the modification kits are installed. The Air Force is modifying KC-135A strategic tanker aircraft to replace the existing engines, strengthen the main landing gear, and make other system improvements. The modified aircraft, designated KC-135R, was first delivered in June 1982. The design of the modification is stable, having been in production for 8 years. The Air Force procured 29 aircraft modifications with fiscal year 1990 funding.

The cost of engines to be installed during the modification efforts represents over 60 percent of the annual component cost of the program. Because the engine is primarily produced for commercial use and, according to the contractor's representative, a clause in the Air Force contract provides for varying quantities within certain limits, changes in the Air Force' s procurement rates do not significantly affect the unit cost of that engine.

The prime contractor has several other manufacturing and modification programs in its business base. If the annual quantities of the KC-135R are reduced, the contractor can move some direct and sustaining labor to

other projects in the facility.[4] The ability to shift labor to other projects in which personnel are needed to fill vacancies can reduce potential increases in both direct labor and overhead charges.

Table 1 shows the Air Force's projected KC-135R procurement unit cost sensitivity for varying annual procurement rates in fiscal year 1990. This table projects an increase of about 3 percent in unit cost if the number to be purchased is decreased by 33 percent (from 36 to 24 aircraft) and a 6 percent increase in unit cost if the quantity is halved (from 36 to 18).

Table 1: Sensitivity of Unit Cost to KC-135R Quantities Procured
(Fiscal Year 1990)

Dollars in millions

Procurement rate decrease/ increase	Quantity procured	Unit cost	Unit cost percent change
50% decrease	18	$18.7	+6
33% decrease	24	18.1	+3
Estimated program	36	17.6	0
25% increase	45	17.1	−3
50% increase	54	16.5	−6

F/A-18 Aircraft

The unit cost for the Navy's F/A-18 aircraft is relatively insensitive to the rate at which units are procured, especially when the procurement rate is reduced by 25 percent. The F/A-18 is a mature program; it had its first flight in 1978 and reached its initial operating capability in 1983. According to DOD, the Navy contractor can use foreign military sales to stabilize the F/A-18 production line and unit prices. DOD reduced the planned procurement in fiscal year 1990 from 84 aircraft per year to 72 and then to 66 aircraft, resulting in a reduction of almost $800 million in planned funding levels. Navy officials considered 84 aircraft per year as the minimum economical production rate based on an 8-hour workshift working five days a week. The officials believed that foreign sales could compensate for the decreased procurement rate and keep the production line operating at an economic rate.

Table 2 shows the projected unit procurement cost of the F/A-18 in fiscal year 1990 at various annual procurement rates. It projects an increase of about 8 percent in unit cost if the procurement rate is

[4]Sustaining labor is labor that supports the manufacturing process. It includes such items as engineering, tooling, drawing maintenance, or technical support. Direct labor is labor that can be specifically and consistently identified or assigned to a particular work order/contract and that bears full overhead.

decreased by 25 percent (from 72 to 54 aircraft). If the procurement rate is halved, however, there will be a 24 percent increase in unit cost.

Table 2: Sensitivity of Unit Cost to F/A-18 Quantities Procured
(Fiscal Year 1990)

Dollars in millions

Procurement rate decrease/ increase	Quantity procured	Unit cost	Unit cost percent change
50% decrease	36	$31.9	+24
25% decrease	54	27.8	+8
Estimated program	72	25.7	0
25% increase	90	24.0	−7
50% increase	108	22.9	−11

F-16 Aircraft

The F-16 aircraft's unit cost is also relatively insensitive to procurement rate changes when the rate is reduced by 25 percent. It has been in production since 1977. The Air Force has acquired the F-16 under multiyear contracts since 1982 and is currently negotiating a multiyear contract to fill fiscal year 1990 through 1993 procurement requirements. The F-16 has had many configuration changes that have increased the cost of the aircraft. According to the prime contractor, multiyear contracting has helped offset the magnitude of the potential cost increases by stabilizing the production line and by permitting the contractor to obtain volume discounts for some parts and materials.

The contractor also has sold a relatively large number of F-16s to foreign customers for many years. It has sold over 100 F-16 aircraft each to Egypt, Israel, Turkey, and the Netherlands. In fiscal year 1990, the Air Force reduced its procurement request to 108 per year, expecting that foreign sales would keep production at a minimum efficient rate of 120 aircraft per year.

Table 3 shows the Air Force's projected F-16 procurement unit cost sensitivity at varying rates. It projects an increase of about 12 percent in procurement unit costs if the procurement rate is decreased by 25 percent (from 120 to 90 aircraft). It also projects that if the number of aircraft bought is halved, there would be a 34 percent increase in unit cost.

Table 3: Sensitivity of Unit Cost to F-16 Quantities Procured
(Fiscal Year 1990)

Dollars in millions

Procurement rate decrease/ increase	Quantity procured	Unit cost	Unit cost percent change
50% decrease	60	$34.1	+34
25% decrease	90	28.6	+12
Estimated Program	120	25.5	0
25% increase	150	23.5	−8
50% increase	180	23.0	−10

AV-8B Aircraft

The Navy's AV-8B Marine Corps attack aircraft unit cost is relatively insensitive to procurement rate changes. In fiscal year 1989, the Navy was given the authority to enter into a 3-year contract for annual quantities of 24 AV-8B aircraft.[5] This quantity was significantly below the prior years' procurement quantities. The reduction increased the procurement unit cost by about 12 percent. According to the Navy, unit costs would have increased more significantly, but multiyear procurement enabled the contractor to stabilize the work force and to obtain volume discounts for parts and materials. According to the Navy, foreign military sales avoided production line stoppages.

Table 4 shows Navy AV-8B contract prices at various procurement quantities.[6] Foreign procurements are included because they are priced along with the Navy procurements. Despite a total quantity decrease of over 62 percent (from 66 in fiscal year 1987 to 23 in fiscal year 1989), a comparison of the lowest unit price ($11 million in fiscal year 1987) with the multiyear unit price ($12.4 million) shows an increase of about 12 percent in unit price.

[5]In fiscal year 1988, 8 aircraft were prospectively priced for fiscal year 1989. As a result, the multiyear quantity of 24 aircraft was decreased to 16 for 1989.

[6]The table shows contract pricing information because the AV-8B program office did not provide unit cost sensitivity data.

Table 4: AV-8B Procurement Unit Costs
(in Fiscal Year 1989 Prices)

Dollars in millions

Fiscal year	U.S. Navy quantity	Foreign quantity	Total units	Unit price
1986	46	24	**70**	$12.2
1987	42	24	**66**	11.0
1988/89	32	24	**56**	11.1
1989/MYP[a]	16	7	**23**	12.4
1990/MYP	24	0	**24**	12.4
1991/MYP	24	0	**24**	12.4

[a]MYP is the acronym for multiyear procurement.

F-15 Aircraft

The Air Force's F-15 is also relatively insensitive to procurement rate changes when the number of aircraft to be bought is reduced by 25 percent. It has been in production since the early 1970s and has been produced in five major models. The final procurement of the current version, the F-15E, is scheduled for fiscal year 1991. The history of F-15 production shows how labor and overhead can be minimized when production rates are reduced.

According to the prime contractor, it could absorb the impact of modest reductions in the F-15 procurement rate by moving some of its direct factory labor to other production lines in the facility where additional personnel are needed to fill attrition or program expansion vacancies. It could also move some of its sustaining engineers to fill vacancies in other in-house programs.

In fiscal year 1989, the F-15 procurement quantity was reduced from 42 to 36 aircraft per year. The negotiated unit price did not increase significantly (less than 4 percent). Total program funding (in 1989 dollars) was reduced by about $38 million.

Table 5 shows the Air Force's projected unit procurement cost sensitivity for varying annual quantities. It projects a recurring flyaway unit cost increase of about 10 percent when the procurement rate is decreased by 25 percent (from 36 to 27 aircraft).[7] If the number to be purchased per year is halved, there will be a 28 percent increase in unit cost.

[7]The F-15 data is presented as recurring flyaway costs because that is how the program office figures F-15 costs. Recurring flyaway costs should include those elements (such as fabrication, assembly, and manufacturing) that occur repeatedly during production.

Table 5: Sensitivity of Unit Cost to F-15 Quantities Procured
(Fiscal Year 1990)

Dollars in millions

Procurement rate decrease/ increase	Quantity procured	Unit cost	Unit cost percent change
50% decrease	18	$42.9	+28
25% decrease	27	36.8	+10
Estimated program	36	33.5	0
25% increase	45	32.0	−4
50% increase	54	31.2	−7

Conclusions

The fact that the unit cost of some aircraft systems could be less sensitive to a decrease in production rates than others is not by itself sufficient reason to favor extending production at lower rates. From the point of view of saving money, terminating production might be the more sensible choice. It should also be noted that unit costs are less sensitive when rate reductions are planned and fixed costs can be reduced For this reason contractors should be given sufficient advanced notice of production rate decreases. In any case, the information in this report should not be interpreted as meaning that stretching out production is preferable to terminating programs. Each aircraft system must be evaluated on a case-by-case basis. Nevertheless, DOD's unit cost projections for aircraft and other defense systems could assist the Congress in determining the costs of stretching out production of some systems.

Scope and Methodology

To evaluate the sensitivity of procurement unit costs to procurement rate changes, we obtained and analyzed cost data from the DOD planning and budgeting cycles. We also reviewed program office cost estimates and compared that information with other DOD documents.

We discussed with program officials and prime contractors the various factors that could influence aircraft unit costs. To obtain an understanding of the aircraft manufacturing process and the factors that can influence unit costs, we met with officials from McDonnell Douglas Aircraft Corporation, St. Louis, Missouri; General Dynamics Corporation, Fort Worth, Texas; and Boeing Military Airplane Company, Wichita, Kansas. We also toured their aircraft facilities.

In addition, we discussed these factors with DOD officials located at each contractor facility, program office manufacturing and cost-estimating specialists, Air Force and Navy headquarters officials, and officials in

the office of the Assistant Secretary of Defense for Production and Logistics.

Our work was conducted between September 1989 and July 1990 in accordance with generally accepted government auditing standards.

As requested we did not obtain written agency comments on this report. However, we discussed a draft of this report with DOD and Air Force officials, and their comments have been incorporated where appropriate.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days from the date of this letter. At that time, we will send copies of this report to the Chairmen, House Committees on Appropriations and on Government Operations and Senate Committee on Governmental Affairs, and the Secretaries of Defense, the Navy, and the Air Force. Copies will be made available to other interested parties on request.

This report was prepared under the direction of Paul F. Math, Director, Research, Development, Acquisition and Procurement Issues, who may be reached on (202) 275-4587 if you or your staff have any questions. The major contributors to this report are listed in appendix I.

Frank C. Conahan
Assistant Comptroller General

Major Contributors to This Report

National Security and International Affairs Division, Washington, D.C.

Michael E. Motley, Associate Director
James Wiggins, Assistant Director
Thomas Mills, Issue Area Adviser
John Potochney, Senior Evaluator

Cincinnati Regional Office

Robert Murphy, Issue Area Manager
Rae Ann Sapp, Evaluator-In-Charge
James Gabriel, Evaluator
Johnetta Gatlin-Brown, Evaluator